Appendix E

State of Montana's
Revised Restoration Plan
For The
Clark Fork River
Aquatic and Riparian Resources

Montana Department of Justice
Natural Resource Damage Program

November 2007

Revised DRAFT

STATE OF MONTANA'S
REVISED RESTORATION PLAN FOR THE CLARK FORK RIVER
AQUATIC AND RIPARIAN RESOURCES

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STATE OF MONTANA'S REVISED RESTORATION PLAN FOR THE CLARK FORK RIVER AQUATIC AND RIPARIAN RESOURCES

SECTION 1. INTRODUCTION

Natural resource damages under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U. S. C. § 9601 *et seq.,* (CERCLA) are designed to compensate trustees[1] for injury[2] to natural resources.[3] In 1983, the State of Montana (State) filed a lawsuit in federal court against the Atlantic Richfield Company (ARCO) for natural resource damages that have arisen as a result of ARCO's and its predecessors' mining and smelting operations in the Upper Clark Fork River Basin (UCFRB), particularly around Butte and Anaconda. Hazardous substances released from these operations for the last 130 years have injured Montana's natural resources, particularly its fish, wildlife, and water resources. In 1995, as part of that litigation, the State issued a Restoration Determination Plan (RDP). Based on information then available about projected EPA response actions to be undertaken at the UCFRB, the RDP quantified natural resource damages to which the State was entitled in order to restore the injured natural resources.

[1] The State of Montana is a trustee of natural resources within the state. CERCLA Section 107 (f)(l), 42 U.S.C. §9607(f)(1).

[2] As trustee, the State is entitled to "damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from" the release of a hazardous substance (CERCLA Section 107(a)(4)(C), 42 U.S.C§ 9607(a)(4)(C)).

[3] "The term natural resources means land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by" the State (CERCLA Section 101(16), 42 U.S.C.§ 9601(16)).

Among other resources, the RDP identified the costs to restore the aquatic and riparian resources in and along the Clark Fork River.

In 1999, the federal court approved a partial settlement of the Montana v. ARCO lawsuit. That settlement, however, did not resolve the State's restoration damages claims for the "Step 2 Sites," one of those Step 2 sites being the Clark Fork River Aquatic and Riparian Resources. The State, the United States, and ARCO recently lodged additional consent decrees with federal district court, which, among other things, would settle the State's outstanding restoration damages claim for the Step 2 Sites. ARCO has agreed to pay $72.5 million plus interest to resolve the State's natural resource damage claims for the Step 2 Sites.[4] The consent decree allocates 39.3% of the settlement money, after payment of assessment and litigation costs, i.e. approximately $27.5 million, to the Clark Fork State Restoration Account to restore, rehabilitate, replace or acquire the equivalent of the injured natural resources in and along the Upper Clark Fork River and its tributaries.

In May 2004, the Record of Decision (ROD) for the Clark Fork River Operable Unit (CFROU) was released by the United States Environmental Protection Agency (EPA). The ROD included a description of the response actions to be undertaken along the river. In light of information contained in the ROD, other data and documents,[5] and in order to account for the recent settlement of its NRD claim for injuries to the Clark Fork River Aquatics and Riparian Resources, the State issues this revised "Restoration Plan" for the Clark Fork site.

A revision of the 1995 RDP for the Clark Fork site is now appropriate because the ROD and other documents more definitively set forth the expected nature and extent of EPA's response actions to be undertaken in this area than was estimated by the State in 1995. This added certainty regarding response actions now enables the State to craft restoration actions that not only mesh with EPA's selected remedy, but also, take into account the pending settlement with

[4] In addition to this payment, as consideration for the settlement, ARCO is conveying certain water rights to the State and the 343 acre "Beck Ranch," which is located near Deer Lodge but not along the Clark Fork River.

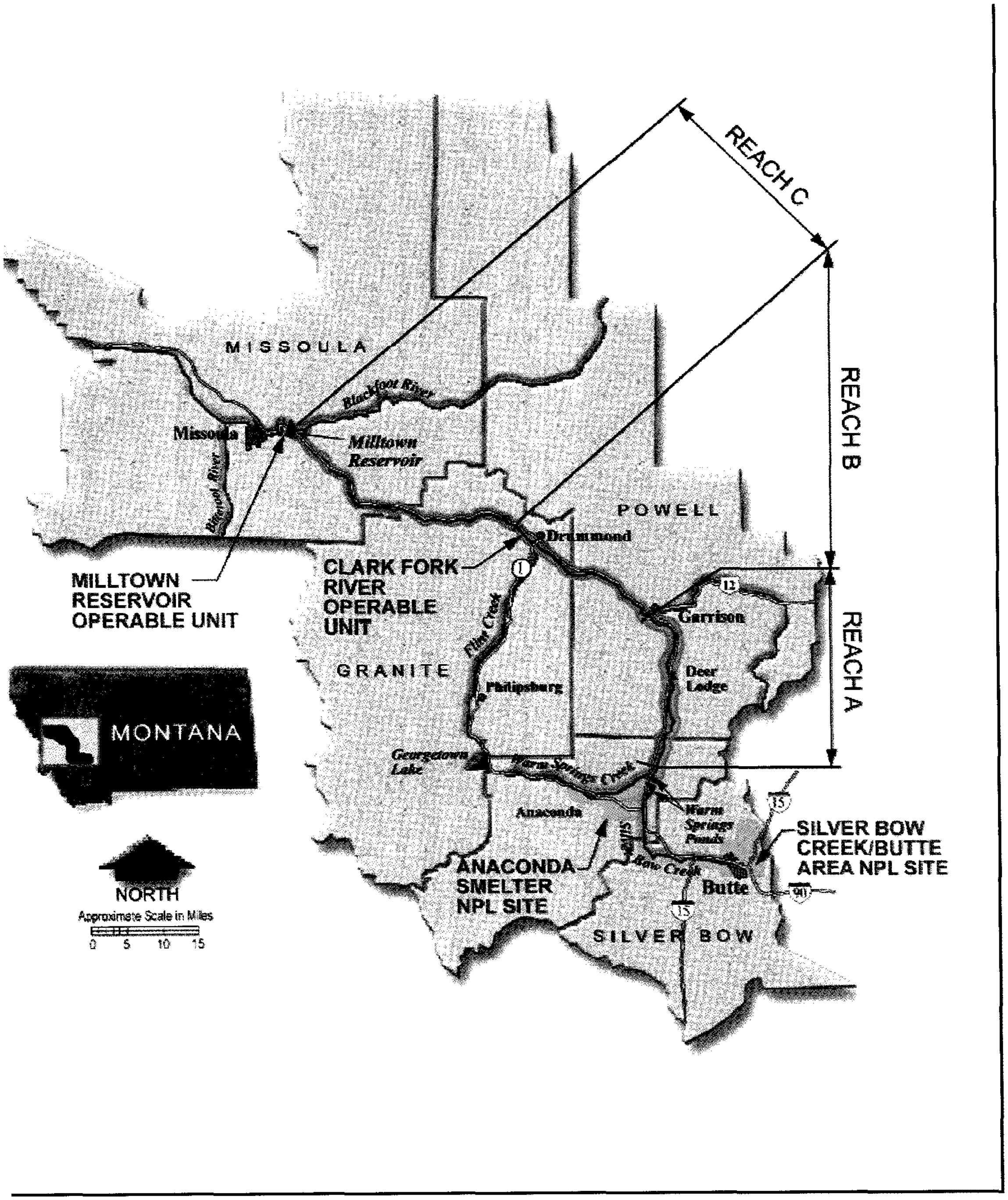
[5] The State also relied on documents such as the State's Aquatic and Terrestrial Injury Reports (NRDP, 1995b) and remedial documents such as the Remedial Investigation and Feasibility Study (Pioneer, 2002).

ARCO, including the amount of natural resource damages to be received by the State for restoration of the Clark Fork site. In addition, these circumstances allow for an integrated response/restoration action that should maximize gains to the injured resources while increasing cost effectiveness and cost savings.

1.1. DESCRIPTION OF THE SITE AND SOURCE OF HAZARDOUS SUBSTANCES

Aquatic and riparian resources of the Clark Fork River from Warm Springs Creek to Milltown Reservoir have been injured by the hazardous substances, including arsenic, cadmium, copper, lead, and zinc released from mining and mineral-processing operations in the Butte and Anaconda areas. The headwaters of the Clark Fork River are formed by the confluence of Warm Springs Creek and Mill and Willow Creeks at the Mill-Willow Bypass. From its headwaters, the Clark Fork River flows north for approximately 43 miles past the towns of Galen, Deer Lodge, and Garrison (this stretch is designated as Reach A). The river then runs northwest for approximately 77 river miles to the Milltown Reservoir near Bonner (this stretch includes what is designated as Reach B and Reach C). Figure 1 shows the Clark Fork River and the reaches of the operable unit.

In the late 1800's and early 1900's Silver Bow Creek and Warm Springs Creek carried wastes from mining, milling, and smelting operations in the Butte and Anaconda areas directly to the Clark Fork River and its floodplain prior the construction of Opportunity and Warm Springs Ponds (Figure 1). Disposal activities prior to the construction of these ponds contributed the bulk of contamination to the Clark Fork River. In 1911, the first of the Opportunity Ponds was constructed and, in 1918, the first two sedimentation ponds (Ponds One and Two) were constructed at Warm Springs, just upstream from the headwaters of the Clark Fork River. These ponds and several other ponds constructed later helped curtail the amount of waste carried into the Clark Fork River. A third, much larger settling pond was built at Warm Springs in the late 1950's. It was estimated in the Warm Springs Pond Remedial Investigation (MDHES and CH2MHill, 1989) that more than 19 million cubic yards of sediment



Basemap from EPA

TETRA TECH, INC.
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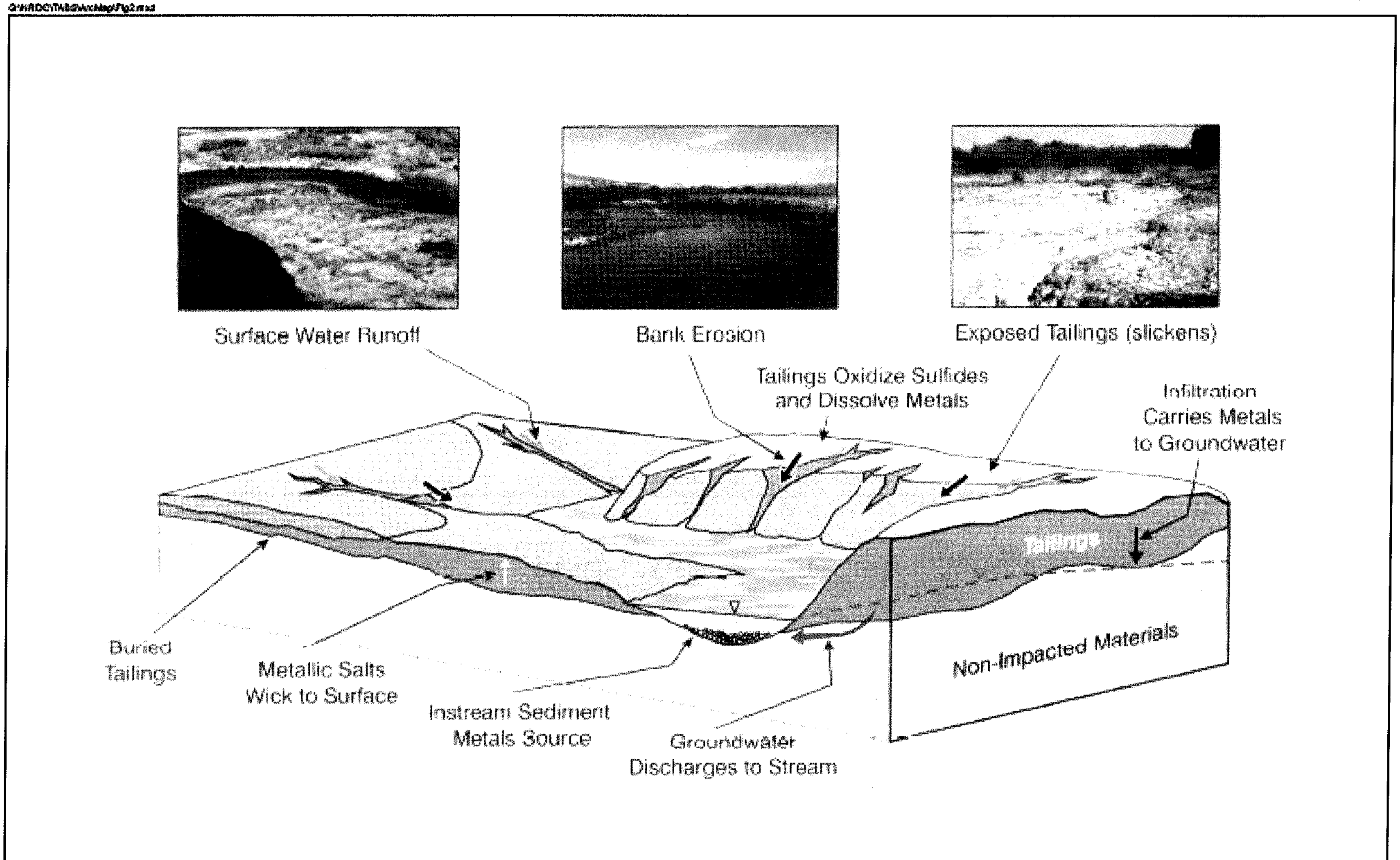
Site Map
Clark Fork River Operable Unit
Figure 1

were contained by the three settling ponds. Since 1990, significant remedial actions have been conducted at the Warm Springs Ponds and these actions have substantially improved the efficiency of the sedimentation ponds. At the present time contaminated water from Silver Bow Creek is treated by lime in Pond Three and Pond Two. Although these ponds do improve water quality and prevent significant quantities of mining and milling wastes from moving downstream, release of hazardous substances, particularly arsenic, to the Clark Fork River continues to this day via the Mill-Willow Bypass and via the Pond Two outflow. For example, the 2005 Five Year Review Report on the Warm Springs Ponds Operable Units, prepared by EPA, indicates that arsenic exceeded the monthly standard 45% of the time and arsenic exceeded the daily standard 44% of the time. A more complete review of the ponds performance is found in EPA's 2005 Five Year Review Report.

Hazardous substances contaminate large areas of the Clark Fork River floodplain, including the riverbanks. Figure 2 is a conceptual drawing of the contamination mechanisms that occur along the Clark Fork River. Floodplain contamination consists of mine tailings, mixed alluvium and tailings, and soils contaminated by hazardous substances originating from tailings. Tailings and contaminated soils are cycled back and forth between aquatic and riparian environments. Floodplain tailings and contaminated soils in turn contaminate surface water and riverbed sediments through releases of hazardous stances by surface runoff, scouring during bank full and overbank high flows, and riverbank wasting and slumping. Similarly, hazardous substances are deposited on the floodplain during overbank high flows. Most of these hazardous substances are located in Reach A, with an estimated 9.6 million cubic yards of tailings affecting approximately 3,570 acres. Reach B has an estimate of 2.1 million cubic yards of tailings that affect 840 acres of floodplain (Pioneer, 2002). Metal-contaminated soils cover approximately 9,000 additional acres of floodplain extending along the entire length of the river. The release of these hazardous substances directly impairs the aquatic and riparian resources of the Clark Fork River (NRDP, 1995b).

1.2. DESCRIPTION OF INJURY

Fish populations have been depressed within the Upper Clark Fork River for more than a century as a result of hazardous substance releases from mining, milling, and smelting activities in the headwaters area of the Clark Fork River basin. Aquatic injury caused by the release of hazardous substances along the Clark Fork River is extensive and has been the subject of numerous studies and reports and is an integral part of the State's Natural Resource Damage (NRD) lawsuit against Atlantic Richfield Company (ARCO). Montana's Aquatic Injury Assessment, including its trout population study, show that trout numbers within the Clark Fork River are only about 20% of the populations in similar rivers within southwest Montana due to exposure to hazardous substances released from Butte and Anaconda mining, milling, and smelting activities (NRDP, 1995a). Additional studies conducted by Stratus Consulting for the State of Montana show that metals and arsenic are reducing the growth of trout and, consequently, the study shows that arsenic and metals in the diet are likely a cause of reduced trout populations within the Upper Clark Fork River Basin (Stratus, 2002). The injury to aquatic life along the entire Clark Fork River from Warm Springs Ponds to Milltown also includes aquatic insects (benthic macroinvertebrates), which are a critical food source for fish. Benthic macroinvertebrates living in and on the riverbed accumulate hazardous substances in their tissues



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Conceptual Contamination Mechanisms
Clark Fork Operable Unit
Figure 2

(Hornberger, *et al*, 2003). Consumption of benthic macroinvertebrates by trout results in exposure and injury, including death, reduced populations, and diminished growth.

Contaminated floodplain deposits have also injured riparian resources, depriving wildlife of habitat. The most severe floodplain contamination, as evidenced by the occurrence of non-vegetated or sparsely vegetated tailings deposits called slickens or exposed tailings, occurs between Warm Springs and Garrison. In general, concentration of hazardous substances in floodplain deposits and the occurrence of non-vegetated tailings decrease in a downstream direction. Because the floodplain is substantially lacking extensive woody vegetation on the stream banks and in the riparian corridor that once existed throughout the Deer Lodge valley, it is highly susceptible to ongoing bank erosion as well as the potential for catastrophic floodplain destabilization or unraveling (Smith and Griffin, 2002).

In summary, natural resource injuries to the Clark Fork River by releases of hazardous substances are documented by the following:

- Surface water contains concentrations of hazardous substances that exceed criteria established for the protection of aquatic life and exceed thresholds that have been demonstrated to cause injury to fish;
- Bed sediments contain hazardous substances at concentrations that exceed baseline conditions by, on average, a factor of more than ten, and exceed concentrations that are expected to injure benthic macroinvertebrates;
- Benthic macroinvertebrate tissues contain elevated levels of hazardous substances;
- Consumption of contaminated benthic macroinvertebrates by trout has been shown to cause reduced growth;
- Trout populations are approximately 20% of baseline levels due to exposure to and avoidance of contaminated surface water and consumption of contaminated benthic macroinvertebrates;
- Rainbow trout are largely absent from the Clark Fork River upstream of its confluence with Rock Creek;

- Populations of otter, mink and raccoons that rely on fish and benthic macroinvertebrates in their diets are significantly reduced relative to baseline conditions;
- Approximately 200 acres of floodplain contain phytotoxic concentrations of hazardous substances to the extent that they are entirely or largely devoid of vegetation having no or little capacity to support viable wildlife populations; and
- Thousands of additional floodplain acres containing tailings and contaminated soils are limited, to various degrees, in the quantities and types of vegetation they can support and are a continuing source of hazardous substances to aquatic and riparian resources.

1.3. Overview of CERCLA Response Actions

The State and its contractors have reviewed the ROD for the CFROU and have participated in discussions with EPA and its contractors regarding the remedy. The State, via DEQ, concurred on the CFROU ROD. The ROD set forth the remedy for the CFROU. The following is the selected remedy as outlined in the ROD for Reach A and for limited areas within Reach B. No action is proposed by the ROD for Reach C. The remedy is described in general terms here and in greater detail in Section 2.

- The ROD defines exposed tailings areas. Exposed tailings will be removed, and revegetated, with limited exceptions.
- The ROD defines areas of impacted soils and vegetation. The areas of impacted soils and vegetation, except in certain circumstances, will be treated in place, using lime addition, soil mixing, and re-vegetation.
- The Riparian Evaluation System (RipES) will be used in remedial design to identify exposed tailings and impacted areas and areas where the exceptions to removal or in-situ treatment will apply.
- RipES will also be used to delineate streambank conditions and provide other information regarding site conditions, such as weed content, wetlands locations, and similar information.
- Stream banks will be stabilized by "soft" engineering or hard engineering techniques where conditions warrant for those areas classified, through the use of RipES, as Class 1,

Class 2, or Class 3 stream banks. An approximate, flexible 50-foot riparian buffer zone will be established on both sides of the river.

- Opportunity Ponds will be used for disposal of all removed contamination.
- Best Management Practices (BMPs) and institutional controls will be used throughout Reach A and in limited areas of Reach B to protect the remedy.
- Monitoring during construction, construction BMPs, and post-construction environmental monitoring are required.

Section 2 of this Plan expands on the specifics of Remedial Actions planned for the Clark Fork River and how the proposed restoration actions will be coordinated with the proposed remedial actions.

1.4. Description of Residual Injury

Residual injury is the injury to natural resources that remains unaddressed following implementation of the remedy. This concept is predicated on the fact that response actions can improve the condition of injured natural resources and thereby lessen natural resource injury. The ROD recognizes, however, that "the selected remedy is not intended to and will not restore natural resources in and along the Clark Fork River to baseline conditions." The State recognizes that the remedy effort will remove some of the hazardous substances along the floodplain, but also asserts that baseline condition[6] will not be achieved by the EPA remedy.

The State's revised Restoration Plan builds on the remedy actions that EPA has proposed. After remedial action, hazardous substances will remain on much of the floodplain, stream banks, and riverbed of the Clark Fork River between Warm Springs and Milltown Reservoir. Contaminant sources remaining after remedy include approximately 9,000 acres of metal-contaminated soils, approximately 3,500 acres of untreated tailings-impacted floodplain, contaminated riverbanks and riverbed sediments along 120 miles of river channel, and the 700 acres of in-situ treated soils.

[6] DOI regulations define the term "baseline," as the condition of the resource had the release of hazardous substances not occurred (43C.F.R. §11.14 (e).)

This Restoration Plan presents five major components that, as an addition to the remedial action, are intended to restore the Clark Fork River natural resources to baseline conditions over a period of time:

1) Removal of additional tailings and contaminated material;
2) Stream bank stabilization within Reaches B and C and aquatic and terrestrial habitat improvements throughout the river;
3) Planting additional willows and other vegetation for floodplain stabilization;
4) Protecting the remedial and restoration work within floodplain areas via land acquisitions or easements; and
5) Tributary restoration and replacement actions.

These restoration components are outlined in detail in Section 4 of this plan.

Even though considerable quantities of hazardous substances will remain in the Clark Fork River floodplain, these restoration actions will expedite the recovery time for aquatic and terrestrial resources in and along the Clark Fork River. The time frame necessary to complete these restoration actions will be the same as the estimated implementation time frame of ten years for remedy. Consequently, remediation and restoration are anticipated to occur simultaneously.

SECTION 2. DESCRIPTION OF EPA'S REMEDY

This section presents additional details of EPA's remedy actions for stream bank and tailings remediation in the CFROU as presented in the ROD.

The majority of the remedial action will occur in Reach A with a much smaller component to take place in Reach B and no remediation work in Reach C. The components of the ROD actions are summarized in Section 1.3 of this report; however, the two major components of remedy, stream bank remediation and tailings treatment are described more fully here.

2.1. STREAM BANK REMEDIATION

Under the ROD, a stream bank and riparian buffer zone (SRBZ) will be established along large portions of Reach A to reduce effects on the river from bank erosion of contaminated materials. The establishment of this zone will also help protect the floodplain from excessive over bank erosion during high water flows. The SRBZ extends approximately 50 feet on each side of the river's edge. Within the SRBZ, stabilization, tailings removal or treatment and revegetation requirements will be determined using the RipES assessment method developed for the Clark Fork River by the Reclamation Research Unit at Montana State University and Bitterroot Restoration, Inc. (2004). At the time this document was prepared, stream banks were classified in three categories, 1, 2, or 3 (CH2MHill, 2003), which are further described in Table 1.

As Table 1 shows, Class 1 stream banks present the greatest ecological risk to the river, whereas Class 3 stream banks are less of a concern but may potentially be eroding and delivering contaminants to the river.

Table 1. Summary of stream bank classification presented in Cost Estimate, EPA's Cleanup Plan for the Clark Fork River (CH2MHill, 2004) as determined by the RipES Model for Reach A of the CFROU.*

Streambank Class	Reach A Length (ft)	Reach A Percentage	Metals Level	Deep Binding Woody Vegetation	Bank Condition	RipES Score
1	87,287	20.0	Contaminated	Missing	Unstable, eroding	< 50
2	285,866	65.5	Probable Contamination	Some	Some instability, erosion	50 – 75
3	63,283	14.5	Potential Contamination	Potential	Generally not eroding	> 75

* These numbers are preliminary and subject to change after completion of the remedial design process.

The stream classifications described in Table 1 were used by the EPA in conjunction with expected bank shear stresses resulting from stream flow to designate four bank treatment types for the Clark Fork River. Remediation conceptual stream bank treatment applications for Reach A stream banks are listed in Table 2.

Table 2. Clark Fork River Reach A conceptual stream bank treatment summary.*

Remedial Stream Bank Treatment	Total Length (feet)	Reach A Percent of Total Length	Total Area (acres)
No Treatment Necessary	25,313	5.6	29.1 acres
Treatment 1 (Vegetation Augmentation)	95,144	20.9	109.2 acres
Treatment 2 (Low Shear Stresses/Flow Velocities)	131,803	29.0	151.3 acres
Treatment 3 (Moderate Shear Stresses/Flow Velocities)	128,923	28.3	148.0 acres
Treatment 4 (High Shear Stresses/Flow Velocities)	55,253	12.1	63.5 acres
Currently Rip-Rapped	18,700	4.1	

Source: Table ES-1 (EPA, 2004)

* These numbers are preliminary and subject to change after completion of the remedial design process.

Although stream bank classifications were not developed for Reach B, it is estimated that there are 960 feet of stream bank in Reach B that will require treatment.

A description of the stream bank treatments adapted from the *Cost Estimate for the US Environmental Protection Agency's Cleanup Plan for the Clark Fork River Operable Unit* (CH2MHill, 2004) were presented in the ROD. The actual stream bank reconstruction designs implemented on the Clark Fork River will be required to meet specific performance standards.

2.2. TAILINGS REMEDIATION

Two tailings treatments are included in the ROD, removal and in-place treatment. Table 3 presents a summary of tailings areas as developed in the Feasibility Study (Pioneer, 2002).

Table 3. Summary of tailings areas and volumes.

Reach A	Area (Acres)*	Volume (cubic yards)
Exposed Tailings	167	430,000**
Buried Tailings with Impacted Vegetation	700	1,070,000**
Buried Tailings with Marginally Impacted Vegetation	2,703	8,100,000
Reach A Totals	3,570	9,600,000
Reach B		
Exposed Tailings	14	40,000**
Buried Tailings with Impacted Vegetation	79	70,000**
Buried Tailings with Marginally Impacted Vegetation	748	1,990,000
Reach B Totals	841	2,100,000
Site Totals	4,411	11,700,000

* Acreage determined using UM polygon vegetation cover class data presented in the Clark Fork River Riparian Zone Inventory Final Report (University of Montana, 1996).

** Areas to be addressed by EPA remediation actions.

Exposed tailings, referred to as slickens, will be removed with limited exceptions. It has been estimated that there are approximately 167 acres comprising approximately 430,000 cubic yards of exposed tailings in Reach A. There are an additional approximately 14 acres comprising approximately 40,000 cubic yards of exposed tailings in Reach B. If the exposed tailings areas are small, that is, less than approximately 400 square feet, less than two feet in depth, and contiguous with impacted soils and vegetation areas, they will be treated in place, those areas may be treated in place.

Impacted soils and vegetation areas will generally be treated in place with lime products to increase soil pH. The ROD estimates approximately 700 acres expected to be treated in-place in Reach A and 79 acres in Reach B. However, if tailings and impacted soils in a given area extend more than two feet below ground surface, the contaminated soils will be removed. The remaining tailings and contaminated soils will either be treated in place or removed, depending on site-specific conditions determined with field data during remedial design. Other impacted soils and vegetation areas that are too wet to allow for implementation of in-situ treatment techniques will also be removed. EPA expects old river channels in the floodplain will often be removed rather than treated in-situ because of these criteria.

All removed tailings and contaminated material will be disposed in the Opportunity Ponds. Exact volumes of material removed or treated in-place will not be determined until final design plans are developed and further design investigation is conducted. EPA proposes to use a scoring system derived from RipES to determine areas to be removed, treated in place, or to receive no treatment.

Depending on various factors, including depth to groundwater, irrigation of reclaimed and revegetated areas may be required until vegetation is re-established. Land management practices will be established to protect the remedy.

SECTION 3. GOALS AND OBJECTIVES OF THE RESTORATION PLAN

The State of Montana's revised Restoration Plan builds on the remedy actions that EPA has selected, which are discussed above. The Restoration Plan will focus on removing additional, identifiable areas of floodplain contamination and reducing current and future loading of metals to the Clark Fork River to restore aquatic resources and riparian wildlife habitat.

The State believes that the Restoration Plan will improve surface and groundwater quality, increase the diversity of the floodplain vegetation, expand the width of the SRBZ riparian corridor (in certain places), improve the stability of the floodplain, improve aquatic and terrestrial habitat, improve trout and wildlife population and enhance recreational opportunities. These enhancements and improvements will help to achieve the following goals and objectives for restoration.

Goal 1: <u>Restore aquatic resources in the Clark Fork River to baseline conditions.</u>[7]

Objective A: Improve water quality and reduce the rate of accumulation of metals and arsenic in bed sediments.

Objective B: Restore in-stream habitat within the Clark Fork River and its tributaries to support the complete life history strategy of salmonids and native fishes.

[7] Baseline fishery conditions in the Clark Fork River were established in consultation with area fish biologists and include the following: (a) salmonid fish density (fish per unit area) similar to reference streams; (b) fish species diversity that includes at least three species of salmonid, two species of sucker [largescale and longnose sucker], one species of sculpin [slimy sculpin], and several members of the minnow family [pea-mouth, northern pikeminnow, longnose dace, and redside shiner]; (c) the presence of at least three year classes of salmonids and suckers, indicating that conditions are suitable in the watershed for reproduction and maintenance of populations over the course of several years; and (d) a ratio of salmonids to suckers greater than one to indicate that baseline water quality and habitat conditions do not favor pollution tolerant species [e.g. suckers].

Objective C: Improve floodplain stability to reduce sediment erosion into the Clark Fork River and reduce migration of metals and arsenic to the stream.

Goal 2: Restore terrestrial habitat to baseline conditions along the riparian zones and floodplains of the Clark Fork River.

Objective A: Restore cover and diversity of vegetation within the floodplain and riparian zone to baseline conditions.

Objective B: Restore habitat complexity of the floodplain to approximate baseline conditions, as estimated by reference stream assessments.

Objective C: Improve floodplain stability through planting of dense stands of willows and shrubs.

Goal 3: Offset the residual effects to flora and fauna from hazardous substances that are not eliminated from the aquatic system.

Objective A: Restore in-stream habitat within the Clark Fork River and its tributaries to support the complete life history strategy of salmonids and other fishes.

Objective B: Improve water quality within the Clark Fork River and its tributaries to support the complete life history strategy of salmonids and other fishes.

Objective C: Improve water quantity within the Clark Fork River and its tributaries to support the complete life history strategy of salmonids and other fishes.

Goal 4: Maximize the long-term beneficial effects and cost-effectiveness of restoration activities.

Objective A: Coordinate restoration activities with remediation to generate cost savings.

Objective B: Develop and implement a plan to preserve, protect, and manage the restored riparian floodplain corridor.

Goal 5: Improve natural aesthetic values of the Clark Fork River.

Objective A: Develop a productive, restored river and floodplain ecosystem to improve natural aesthetics, similar to baseline conditions, and based on reference sites.

SECTION 4. RESTORATION ACTIONS

This proposed Restoration Plan is based on the assumption that all of the EPA actions presented in the ROD for the CFROU will be implemented. The Restoration Plan will result in substantial movement of the Clark Fork River toward baseline conditions over a relatively short period of time, but will not completely return the area to baseline. The proposed restoration alternatives are presented in this section of the plan.

The State is considering several restoration alternatives for the Clark Fork River. Following is a description of restoration actions to be included in various alternatives (Section 4.8) and the resource benefits that would be gained by the implementation of each action.

As a preliminary matter, it should be noted what is not proposed by the following restoration alternatives. First, no alternative proposes to remove all floodplain contamination. It is estimated that at least 13,000 acres of floodplain along the entire length of the Clark Fork River between Warm Springs and Milltown Reservoir are contaminated. Actions are proposed that limit removal to the most significant sources of floodplain contamination. While removal of all floodplain contamination was considered, it was rejected for further analysis because of the difficulties associated with, and adverse impacts anticipated from, such an extensive removal action.

Second, no alternative proposes to remove bed sediments. Among the reasons for rejecting bed sediments removal for detailed consideration is that all reaches of the Clark Fork River contain millions of cubic yards of mine tailings within the floodplain. Not all of these mine tailings will be addressed by the remedial action, and thus, the State believes, that they will continue to erode into the bed of the river and be deposited downstream.

Some of the restoration alternatives include activities that will augment remedial actions, which are focused on the section of the river between Warm Springs Ponds and Garrison (Reach A). Other restoration alternatives include activities that are not associated with any specific remedial actions and will be implemented in and along the Clark Fork River, from Warm Springs Ponds to Milltown Dam, and along portions of the Blackfoot River.

4.1 Removal of Contaminated Tailings and Soil from Floodplain

This section presents removal actions which will remove additional contaminated tailings and soils not removed by remediation. Due to the lack of data, Reach B has not been specifically included; however, during restoration design, areas meeting the criteria discussed below will be targeted for removal in Reach B as well.

The removal actions will help to establish a native, riparian floodplain plant community that contains stands of trees, shrubs, and grasses and forbs within the meander belt width to be established. Moreover, the State believes that the removal actions will improve surface water and groundwater quality, reduce erosion of contaminated soils into the Upper Clark Fork River, and provide uncontaminated source of stream bed sediment. Also, the removal actions will provide the opportunity to restore the floodplain surface topography in limited areas so that it is inundated frequently which will dissipate flood energy, increase nutrient cycling, and promote deposition and storage of fine sediment.

The State resource managers understand the potential implications of the proposed removal actions and technical analyses of each action will be conducted prior to implementation of any action. The State will reduce the backfill only after consultation with landowners and evaluation of geomorphic implications and other factors known and predicted to be impacted by the action.

This restoration plan will consider using the BMPs developed by EPA for the remediation actions; however, additional BMPs will be developed specially for restoration actions, where appropriate, to comply with all appropriate regulations and to protect natural resources.

Four removal actions are considered: 1) The removal of approximately 90 acres of contaminated material classified as buried tailings greater than one-foot in thickness; 2) removal of approximately 700 acres of contaminated material proposed for in-situ treatment by the EPA remedial action (including the 90 acres of buried tailings greater than one-foot); 3) removal of 67 acres of contaminated soils within 50-feet of outside bends of the river that have been identified as "highly erodible", Smith and Griffin (2002); and 4) removal of 157 acres of contaminated soils within 50 feet of outside bends of the river that have been identified as "containing elevated levels of contamination" (including the 67 acres identified as highly erodible).

4.1.1 Removal of Buried Tailings Greater Than 1 Foot Thick

Data from the Remedial Investigation and Feasibility Study (RI/FS) indicate approximately 90 acres of tailings classified as buried tailings greater than one foot in thickness are located outside of the EPA 50-foot SRBZ and will not be removed by remedial actions (Pioneer, 2002). The location of these tailings removal areas is mapped in Appendix B, and an example removal area is shown in Figure 3. Tailings greater than 1-foot thick are the most difficult to treat in-situ with lime due to their thickness. The inability to effectively mix lime completely with the deeper tailings results in areas with high contaminant levels that affect plant growth and vigor, increase the potential that the soils will re-acidify, and decrease the long-term effectiveness of the treatment (Maest, 2002; Kapustka, 2002).[8]

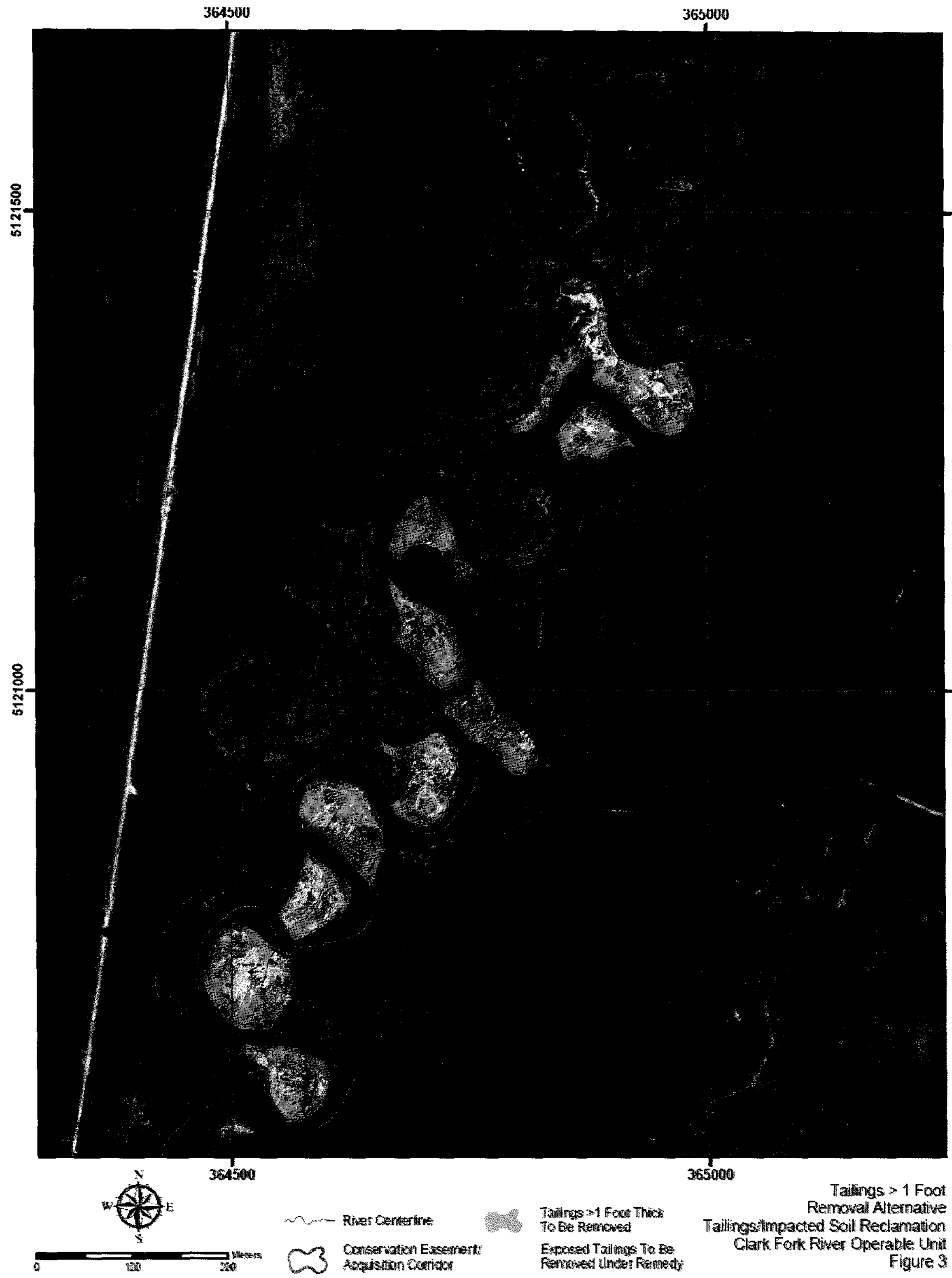
Tailings in the floodplain were deposited by flood flows that have occurred within the last 120 years. Because flood flows such as these were capable of depositing tailings on the floodplain, it stands to reason that future flows have a relatively high probability of being able to re-access these tailings. This action would remove these tailings to prevent remobilization of these deposits.

New in-situ methods are being examined but remain unproven. And no alternative in-situ treatment method effectively removes the contaminants from the floodplain or ensures the long-term effectiveness of in-situ treatment.

[8] During the Governor's Demonstration Project, tests were conducted on deep tillage areas. "Only one-half of the deeper samples collected had an alkaline pH and a lime surplus, indicating about 50 percent mixing efficiency of the deep tillage method" (EPA, 2001).

Due to the uncertainty of the effectiveness of in-situ treatment and the distinct potential for re-entrainment of contaminated floodplain sediments into the Clark Fork River, removal of the 90 acres of buried tailings is justified.[9] Removal would be conducted in the same manner as removal of exposed tailings outlined by the ROD. Tailings along with cover soil and nine inches of buried soil below the contaminated material will be excavated. Local borrow sources would be used for backfill. For this Restoration Plan a maximum of 50% backfill is used. The National Park Service determined in their assessment investigations

[9] It is possible that the final design to implement the ROD will provide for the removal of some of these areas apart from any restoration action.


364500
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River Centerline
Conservation Easement/
Acquisition Corridor
Tailings >1 Foot Thick
To Be Removed
Exposed Tailings To Be
Removed Under Remedy
Tailings > 1 Foot
Removal Alternative
Tailings/Impacted Soil Reclamation
Clark Fork River Operable Unit
Figure 3

on the Grant Kohrs Ranch that the deposition of mine tailings raised the floodplain of the Clark Fork River, which has resulted in the loss of the floodplain connectivity with the river. Backfilling the removal areas only 50% will allow for the floodplain to become reconnected to the river, resulting in more productive vegetation. Under this action approximately 333,960 cubic yards of buried tailings and soils will be removed and transported to Opportunity Ponds using trucks and the infrastructure improved or developed by remedy. Up to 189,600 cubic yards of uncontaminated backfill will be used to replace the excavated tailings.

4.1.2 Removal of Buried Tailing to Be Treated In-situ by Remedial Action

Data from the Remedial Investigation and Feasibility Study (RI/FS) indicate approximately 700 acres of tailings are classified as buried tailings with impacted vegetation and will not be removed by remedial actions (Pioneer, 2002). The EPA ROD indicates these tailings will be treated in-situ with lime to control the acidity of these soils, attenuate and dilute metal contamination, and allow these soils to be successfully revegetated.[10] Tailings in the floodplain were deposited by flood flows that have occurred within the last 120 years. Because past flood flows were capable of depositing tailings on the floodplain, the State believes that future flows have a relatively high probability (over the next 100 years) of being capable of re-entraining these treated tailings into the Clark Fork River even with the implementation of the extensive remedial action. This restoration action would remove these tailings to prevent their remobilization.

Justification for the removal of these tailings is the same, but not as compelling, as it is for the removal of buried tailings greater that 1-foot thick, discussed in Section 4.1.1.

There is some uncertainty as to the effectiveness of in-situ treatment and a distinct potential for re-entrainment of contaminated floodplain sediments into the Clark Fork River; therefore, removal of the 700 acres of buried tailings with impacted vegetation may be justified. Removal would be conducted in the same manner as removal of exposed tailings

[10] The EPA ROD also requires extensive streambank revegetation of the Clark Fork River in Reach A and portions of Reach B.

outlined by the ROD. Tailings along with cover soil and nine inches of buried soil below the contaminated material will be excavated. Local borrow sources would be used for backfill. For this Restoration Plan a maximum of 50% backfill is used.[11] Under this action approximately 1,550,000 cubic yards of buried tailings and soils would be removed and transported to Opportunity Ponds using trucks and the infrastructure improved or developed by remedy.

4.1.3 Removal of Contaminated Soils from Highly Eroding Banks in SRBZ

There are approximately 150,000 feet of highly eroding bends in Reach A, which, when combined with a 50-foot SRBZ, define an area of approximately 165 acres. According to GIS analysis, 75 of these acres are not covered with woody vegetation and therefore have a high probability of containing tailings. Eight of these contaminated acres are exposed tailings or buried tailings greater than one-foot thick, which are already slated to be removed under EPA's remediation plan or this restoration plan and are therefore excluded from this action. This leaves a total of 67 acres that would be removed under this action. See Figure 4.

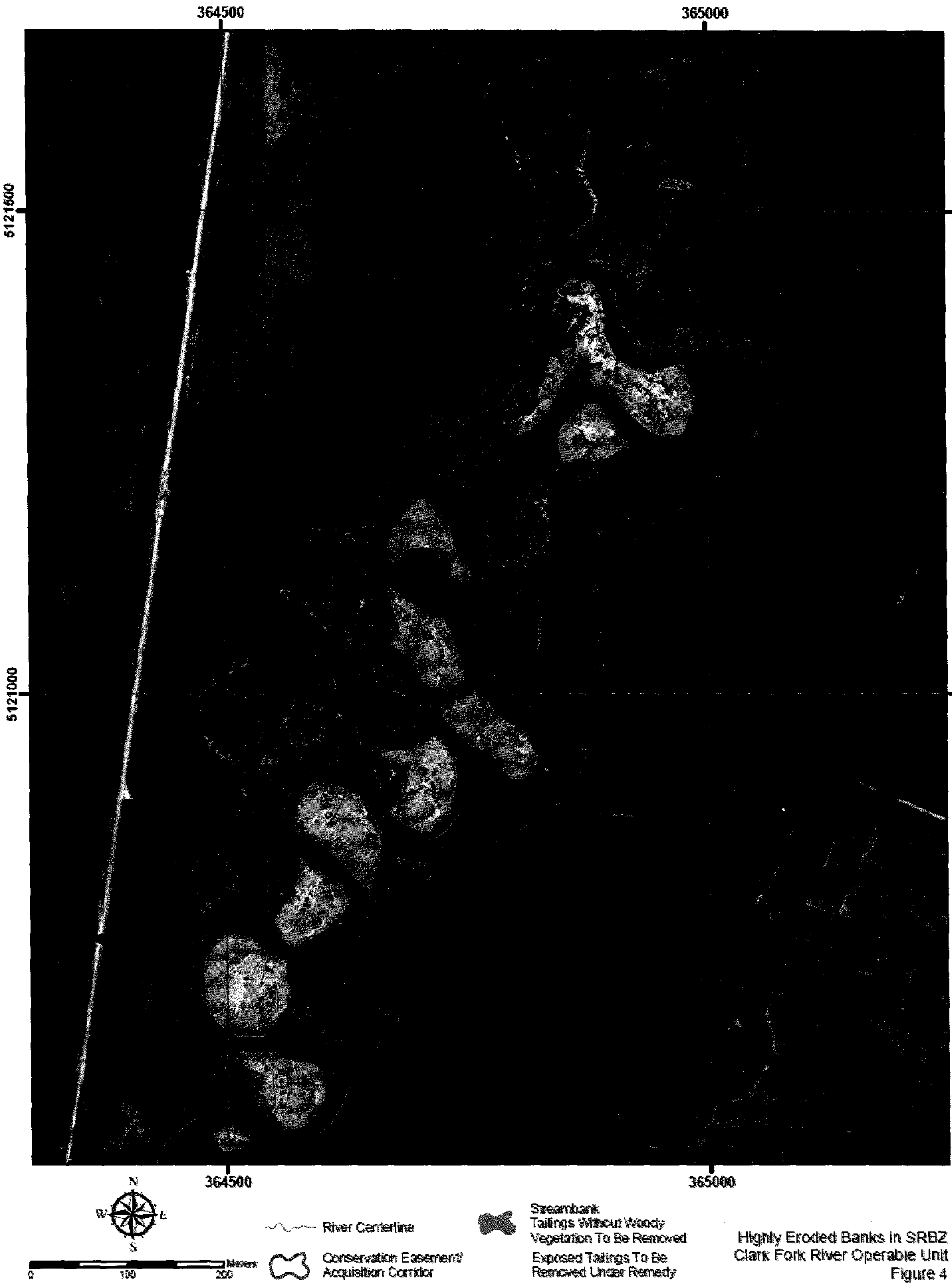
Average removal depths are based on the volumes and areas of tailings in Alternative 7 of the FS, which similarly proposes removal of floodplain tailings without woody vegetation. Allowing a total over-excavation depth of nine inches, the average removal depth would be 1.37 feet, including any soils overlying tailings. Multiplying the average removal depth by the 67 acres yields a volume of 148,100 cubic yards of tailings.

It is anticipated that haul roads required by EPA will be sufficient for the removal of these additional tailings because the areas subject to removal under this action are similar in location to the area of the SRBZ and areas to be treated in place.

The ROD already includes revegetation of the SRBZ, a 50-foot wide zone that also addresses highly erodible bends. The zone proposed for tailings removal in this restoration

[11] It is not unlikely that certain site-specific factors will warrant greater than 50% backfilling, including land-owner preference and land-use consideration.

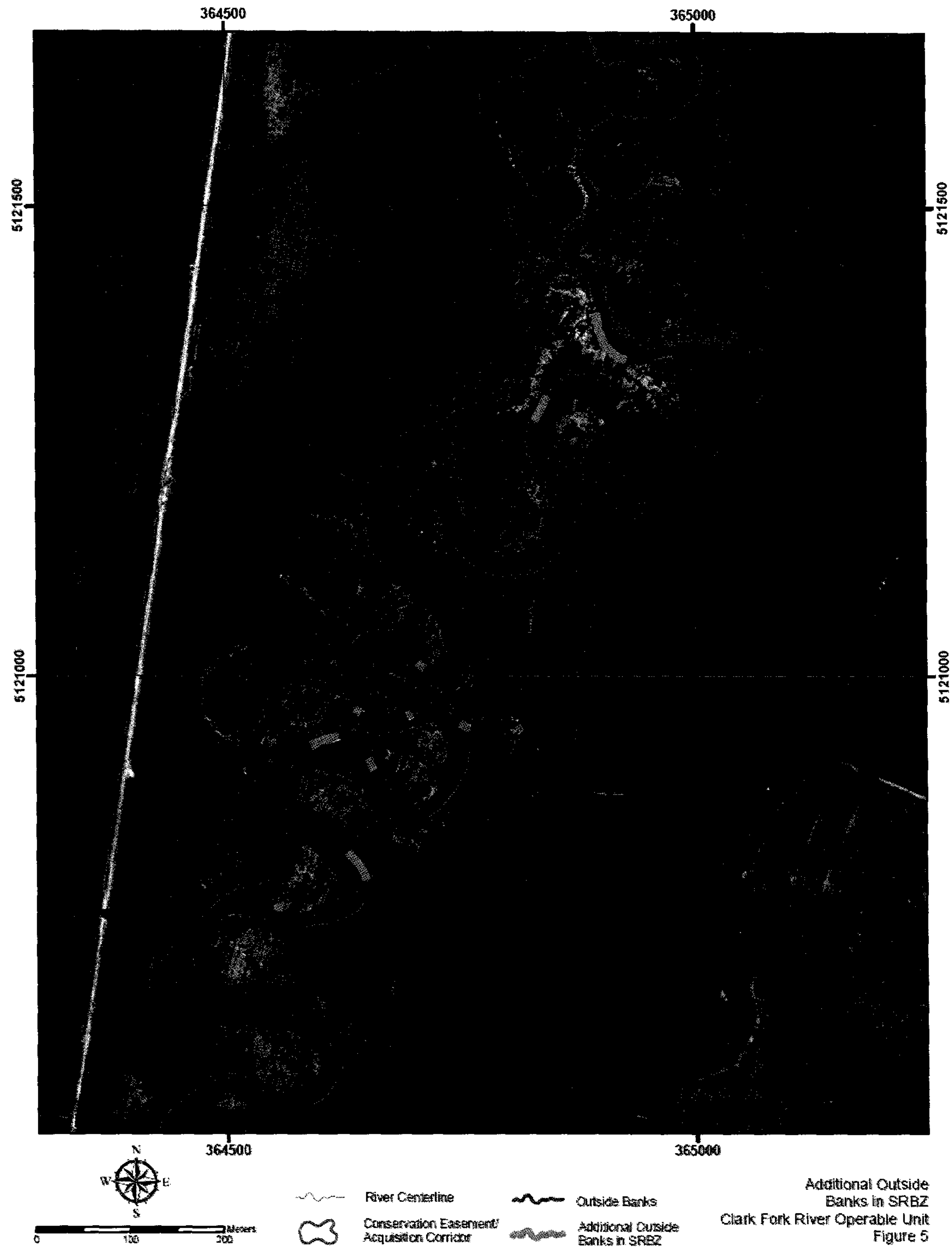
action corresponds closely to the SRBZ where remedial action includes revegetation; therefore, no costs are included for revegetation of the tailings excavation areas for this restoration action. However, revegetation costs are included for reclamation of the additional haul roads if needed and borrow areas. Woody vegetation will be added in accordance with Section 4.3 of this Restoration Plan, Floodplain Stabilization.



Highly Eroded Banks in SRBZ
Clark Fork River Operable Unit
Figure 4

4.1.4 Removal of Contaminated Material from Outside River Bends

Similar to the effects of the contamination from the highly eroding streambanks discussed in the Section 4.1.3, contamination from contaminated streambanks will continue to erode into the CFR for hundreds of years. This potential action would remove additional contaminated material located on the outside of the river bends (50-feet) and replace it with uncontaminated material, Figure 5. GIS analyses estimate 157 acres of material need to be removed to accomplish this action. The 157 acres includes the 67 acres of highly eroded streambanks discussed in Section 4.1.3. An estimated 347,040 cubic yards of material would be removed under this action. This restoration action would restore the 50-foot SRBZ along the outside river bends by removing contamination and backfilling it with uncontaminated fill if necessary. The estimated restoration costs for this action include the excavation and backfilling costs. Remedial action is reconstructing the streambanks and vegetating these areas.



Additional Outside
Banks in SRBZ
Clark Fork River Operable Unit
Figure 5

4.2 AQUATIC RESOURCE IMPROVEMENTS

Aquatic resources on the Clark Fork River need restoration because fish populations are depressed, and actions beyond remedy are needed to return the site to conditions closer to baseline conditions. This portion of the plan addresses aquatic resource restoration through bank and channel stabilization, restoration of vegetation cover, introduction of woody debris in the channel, and re-establishing connectivity between tributary and mainstem fish populations necessary to support all life strategies of salmonids and native fish.

4.2.1 Need for Aquatic Resource Restoration

Fish populations have been depressed within the Clark Fork River for almost a century as a result of releases of hazardous substances from the mining, milling, and smelting activities at the headwaters of the Clark Fork River Basin. Fish population assessments conducted by the State of Montana show that trout numbers within the Clark Fork River are only 20% of populations in similar rivers within southwest Montana (NRDP, 1995b). Also, studies conducted by Stratus Consulting, USGS, and others show that metals and arsenic limit the growth of trout and accumulate in macroinvertebrates within the Clark Fork River Basin (Stratus, 2002, Hornberger, *et al.*, in prep. 2003, Woodward *et al.*, 1995). Based on these and other studies, this restoration plan, among other things, proposes to improve aquatic resources closer to baseline conditions by reducing exposure of aquatic receptors to contamination that will remain in the floodplain after remedial action.

Large volumes of contaminated material are present in Reaches B and C; however, due to the "disperse nature of the contaminated materials within the stream banks, point bars and overbank areas," treatment was determined to be impracticable in these reaches except for the 12 acres of exposed tailings and 79 acres of buried tailings in the upper portion of Reach B. (Pioneer, 2002.) In addition, contaminated sediments within the riverbed are not being addressed at all by remedial or restoration action. These wastes left in place will continue to impact the trout populations of the Clark Fork River (NRDP, 1995). The USGS (Smith *et al.,* 1998) reported that Reaches B and C are the largest source of total suspended sediment to the Clark Fork River. The streambed sediment in the Clark Fork River, including Reaches B and C, contains metal concentrations that are highly elevated relative to reference tributaries. Aquatic macroinvertebrates within these reaches also contain elevated metals, indicating that metal bioaccumulation is occurring throughout the mainstem of the Clark Fork River (Hornberger, *et al.*, in prep. 2003). The levels of metals and arsenic accumulating in the macroinvertebrate population will likely affect the growth rates of trout and their populations as indicated in the Stratus (2002) fish feeding study. EPA states in the Clark Fork River ROD "that streambed sediments will equilibrate over time." However, EPA and USGS "believe that 'over time' means decades or even centuries, based on the hydrology of the basin over the last 100 years." (Smith, et al., 1998.)

In addition to injury related impairments, some portions of the Clark Fork River are channelized in Reaches B and C as a result of railroad and interstate highway construction. The localized channelization has led to bed and bank instability in areas. These localized unstable banks provide little resistance to shear stress, allowing the banks to erode and migrate. As a result of this localized erosion there are areas where the channel is overly wide and does not have sufficient bed scour to maintain pool habitat. In addition, loss of riparian vegetation has greatly diminished the recruitment of large woody debris as fish habitat in the channel and has also reduced overhead cover for fish. All of these injury-related and other habitat impairments provide justification for restoration work in the form of resource replacement in Reaches B and C of the Clark Fork River.

For further support that such additional work is appropriate, it is useful to note that other fishery biologists and aquatic scientists have independently proposed habitat improvement including riparian corridor or bank enhancement with structures, irrigation diversion screening, flow augmentation, and in-stream habitat enhancement (Workman *et al.*, 1999). These biologists also proposed removing tailings and excluding livestock from riparian areas.

4.2.2 Upper Blackfoot River and Other Clark Fork River Tributary Restoration

The Upper Blackfoot River has been identified as an area that should receive restoration improvements, specifically to restore bull trout and westslope cutthroat trout and their habitat. Bull trout is listed as a "Threatened Species" under the Endangered Species Act; westslope cutthroat trout is a "species-of –special-concern" in Montana. Montana Department of Fish, Wildlife and Parks biologists consider opportunities for restoring bull trout populations and habitat to the Upper Clark Fork River Basin (UCFRB) and its tributaries above Rock Creek to be low due to the residual mining-related injuries that will persist long after remediation and restoration actions are completed and other factors. (Personal communications with Pat Saffel and Ron Pierce.) In contrast, the Upper Blackfoot River offers significant opportunities for restoring native fish populations, including bull trout. Consequently, this Restoration Plan proposes to augment the future remedial and restoration actions to be implemented at the Upper Blackfoot River / Mike Horse Site in order to restore bull trout populations and their habitat in the Upper Blackfoot River and its tributaries. Funding such restoration is consistent with the Upper Clark Fork River Basin Restoration Plan Procedures and Criteria (RPPC) and its "project location" criteria, which acknowledges the potential need for restoration outside the Upper Clark Fork River Basin by stating: "The only exception to this geographic requirement [providing for restoration only in UCFRB] would apply to projects, which are intended to restore native trout, which have been injured or impaired in the UCFRB, but which cannot, from a practical or economic standpoint, be restored in the UCFRB; such projects may be located in the Big Blackfoot River watershed."

Other efforts are in progress to evaluate Clark Fork River tributaries, in addition to the Upper Blackfoot River, and their priority to receive restoration improvements. The on-going evaluation will prioritize the Clark Fork River tributaries for future restoration action. These restoration efforts will focus on restoring habitat, water quality, and water quantity critical to developing and maintaining a fishery that resembles baseline conditions in the Clark Fork River. Tributary restoration may include but is not limited to restoring spawning beds, controlling sediment sources, establishing pool habitat, providing instream and overhead cover, controlling fish passage, and maintaining water quality and quantity. This further tributary work will primarily occur outside of this Restoration Plan, and would be funded through the Restoration Fund grants program as provided for in the RPPC.

4.2.3 Clark Fork River Mainstem Restoration

Aquatic resource restoration activities include the stabilization of stream banks and the river channel, and improvement of biologically impaired reaches of the Clark Fork River to reduce the impacts of metals and arsenic on the aquatic resources. The EPA's proposed stream bank remedy is designed to stabilize and revegetate stream banks in Reach A and part of Reach B. This remedy will achieve some of the restoration goals. Consequently, this restoration action would focus on Reach C and the sections of Reach B not covered by the proposed remedy.

Impaired reaches of the Clark Fork River upstream of Milltown Dam, and areas of instability and channelization within Reaches B and C from Turah Bridge to Garrison have been identified. Using topographic maps, aerial photos, on-site observations, river survey data from the 1995 NRDP injury assessment, and the knowledge from river resource managers, it is estimated that approximately 100,000 feet of river are a priority for restoration activities. Improving instream fish habitat will include restoring spawning, rearing, winter, and cover habitat; restoring overhead woody riparian bank cover; increasing woody debris in the channel; promoting the continued recruitment of woody debris; ensuring connectivity of fish populations between tributary streams and the Clark Fork River; and reconnecting abandoned channels where feasible. By improving river function, restoration work in these areas will reduce additional contaminant loading and improve fish habitat.

4.3 FLOODPLAIN STABILIZATION AND REVEGETATION

4.3.1 Revegetation of Woody Species

Stabilization of floodplain tabs within Reach A is needed due to the presence of large volumes of contaminated soils that will remain within the floodplain after remedy and restoration removal actions are complete and because the ROD does not propose stabilization of floodplain tabs outside of the SRBZ. A tab is defined as the portion of the floodplain encompassed by a river bend and the locations of the tabs in Reach A are shown in Appendix C. An example of tab locations is included as Figure 6. Upon completion of remediation and restoration actions, between 9,690,000 and 10,787,940 [12] cubic yards of metals and arsenic contaminated tailings and soil will be left within the floodplain of Reach A along the Clark Fork River. Although the Clark Fork River is currently, in large part, a single thread river, Smith and Griffin (2002) predict that the Clark Fork River is capable of unraveling during an overbank flood due to the absence of stabilizing riparian shrub vegetation on the floodplain. Smith and Griffin assessed all Clark Fork River tabs between Warm Springs Ponds and the Grant-Kohrs Ranch, estimating the shrub cover on each tab. The evaluation of the percent shrub cover was used to identify tabs vulnerable to excessive erosion during overbank flow flood events. Smith and Griffin (2002) concluded that river tabs with less then 40% shrub canopy cover are vulnerable to erosion during overbank flows, which could cause the Clark Fork River to become highly unstable. If this were to occur, millions of cubic yards of contaminated material could be transported into the river, impacting aquatic life for hundreds of miles and hundreds of years.

Even if the complete unraveling that Smith and Griffin (2002) discuss does not occur, there is still a high probability those portions of the Clark Fork River within Reach A may unravel and become braided, causing areas of high erosion and entrainment of contaminated soils. Tabs that are vulnerable to being cut-off are of particular concern. A tab cut-off north of Warms Springs that occurred in the 1940s still has highly eroding banks that

[12] Clark Fork River Operable Unit Feasibility Study (Pioneer, 2002). This range is based on the volumes presented in the 2002 Feasibility Study minus the volume of exposed tailings proposed for removal (430,000 cy) and tailings removed under restoration removal Alternative 1 (1,580,000 cy) or Alternative 2 (482,060 cy).

Floodplain Tabs to be Planted
Clark Fork River Operable Unit
Figure 6

contribute contaminated soils to the river, more than 60 years after the cut-off occurred. Stabilization of the river tabs to prevent other similar cut-offs would reduce potential future contaminant loading to the Clark Fork River.

Some Restoration Plan alternatives would establish shrub vegetation (mostly willows) on tabs that currently have less than 40% shrub canopy cover. Dr. Smith suggests that establishment of shrub canopy cover density greater than 30% would provide only limited protection, while establishment of 90% shrub canopy cover would protect the tabs from eroding during all flood events (Smith and Griffin, 2002). In addition, Smith and Griffin (2002) report that Smith modeled shrub densities and found that tabs with less than 40% shrub canopy cover were an important issue because, on those tabs, there are not enough shrubs to significantly reduce flow velocities in any case. A shrub canopy cover of 60% was chosen as a restoration target to provide a margin of safety against floodplain failure. Sixty percent canopy cover corresponds to a shrub every 15 feet or 193 shrubs per acre according to Smith and Griffin's analysis of willow geometry. Revegetating these floodplain tabs would help protect the Clark Fork River against partial or complete unraveling during most overbank flow events and stabilize meander tabs that may be vulnerable to oxbow cut-offs. Appendix C shows the location of tabs that would receive enhanced plantings in Reach A of the Clark Fork River.

Planting rates on individual tabs will vary due to the density of existing shrubs. All tabs within Reach A with less than 40% canopy cover (129 shrubs per acre) would be revegetated with the required number of willow plants to allow these tabs to achieve 60% cover, assuming 20% mortality in the first five years. The number of plants required to attain 60% cover is calculated by subtracting the existing plant density from the plant density corresponding to 60% cover (193 shrubs per acre) and increasing that number by 20%. Using this calculation method, a total of 29,214 willow plants will be planted on an estimated 201.2 acres. Vegetation will be installed outside the EPA 50-foot SRBZ because the ROD (EPA, 2004) proposes to achieve approximately 80% cover within the SRBZ. Due to the lack of data, Reach B has not been specifically included in this report.

However, during restoration design Reach B will be evaluated, and Reach B floodplain tabs where tailings exist will be similarly targeted for stabilization.

4.3.2 Vegetation Enhancement

Some of the restoration alternatives include, as part of the floodplain stabilization and revegetation, efforts that improve the terrestrial habitat and stream bank stability by developing a riparian floodplain community that contains stands of trees, shrubs, and grasses and forbs. This restoration plan proposes revegetation actions similar to the restoration revegetation efforts taking place along Silver Bow Creek. The areas proposed to be treated with this additional vegetation are the 789 acres within the meander belt including areas of exposed tailings proposed for removal, buried tailings with impacted vegetation slated for in-place treatment, and areas associated with the SRBZ. This action will supplement remedial revegetation efforts. There would be landowner consultation and consideration of the landowners' concerns during this revegetation phase.

All revegetation actions within Reach A would be associated with areas where EPA is proposing remedial actions and would augment the remedial revegetation. EPA has an extensive weed management plan based on landowner concerns. Because restoration areas coincide with EPA remediation and weed management areas, no additional weed management actions are proposed under this restoration plan. However, if restoration actions require additional weed management the State will implement weed management to augment or integrate with the remediation. (It is expected that any additional costs for such weed management would come out of the contingency.)

4.4 FLOW AUGMENTATION

To further address residual surface water and bed sediment contamination, restoration activities include the proposed augmentation of flows in the Clark Fork River with 50 cubic feet per second (cfs) of unimpaired water upstream of Galen downstream to Deer Lodge for two months (mid-July to mid-September) each year. This flow augmentation is based on a minimum flow of 50 cfs requested by Montana Fish, Wildlife and Parks in their in-stream flow application for the Clark Fork River (DNRC, 1991). Trout Unlimited recently completed a study that recommended minimum flow to account for other instream flow data to develop flow recommendations at specific locations along the upper Clark Fork River (Workman, 2004). Trout Unlimited's proposed minimum flows for three Clark Fork River locations are 40 cfs at Galen, 60 cfs at Sager Lane, and 90 cfs at Deer Lodge (Workman, 2004). Historical data for USGS gauging stations located at Galen and Deer Lodge were reviewed and indicate that the addition of 50 cfs should increase base flows enough to meet the minimum flows proposed by Workman (2004).

Flow augmentation would improve water quality by diluting hazardous substances resulting from tailings and contaminated soils left in the floodplain, contamination of riverbed sediments, and current releases of hazardous substances from the Warm Springs Ponds. The additional water flow would also result in cooler water temperatures, provide more habitat variety and reduce stress, enabling fish and other organisms to better survive conditions until restoration actions are complete and recovery is well underway.

To ensure minimum flows are maintained in the Clark Fork River, water rights are to be acquired by the State from ARCO (as part of the pending settlement) and a water commissioner will be hired by the State of Montana. The Montana Department of Fish, Wildlife and Parks have successfully used water commissioners to manage water flows on other drainages; similar procedures will be followed on the Clark Fork River. Costs for this water commissioner position are included in Section 5.4.

4.5 TERRESTRIAL HABITAT RESTORATION

Terrestrial habitat would be enhanced by the stream bank and floodplain restoration efforts discussed in Sections 4.1 and 4.2 and as a result of implementation of the EPA remediation. For example, a dense, diverse, native floodplain plant community would be restored within the meander belt upon implementation of Section 4.3. This plant community would include stands of trees, shrubs, and grasses and forbs to create vertical habitat complexity. Floodplain topography in tailings removal and borrow areas would also be varied to create a mosaic of wetland areas and mesic soil conditions. Old river channels, low areas, or wet areas would be developed or restored to create additional wetlands. Finally, a land use management plan based on BMPs and land acquisitions or conservation easements discussed in Section 4.6 of this plan would be implemented to preserve and protect riparian floodplain vegetation and habitat.

4.6 LAND ACQUISITION / CONSERVATION EASEMENTS

As part of this restoration plan, it is proposed that fee title or conservation easements be acquired over approximately 2,120 acres of floodplain along the Clark Fork River from Warm Springs Ponds to Garrison, but not including the City of Deer Lodge or the Grant-Kohrs Ranch. This action assumes that landowners along this area would be willing to sell such property interests to the State. Sales would be completely voluntary and, if the landowners choose to sell, a reasonable purchase price based upon fair market value would need to be agreed upon.

The primary benefits from conservation easements are that the landowner retains ownership and use of the land while implementing land management practices designed to preserve the remedy and restoration actions.

Conservation easement or land purchases between Warm Springs and Garrison would encompass the meander belt of the river plus 100 feet on both sides of the belt as shown in Appendix C. This width was selected in order to help protect the Clark Fork River riparian zone and the areas being treated by remedial and restoration actions. An example of the planned conservation easement or acquired land is shown in Figure 7.

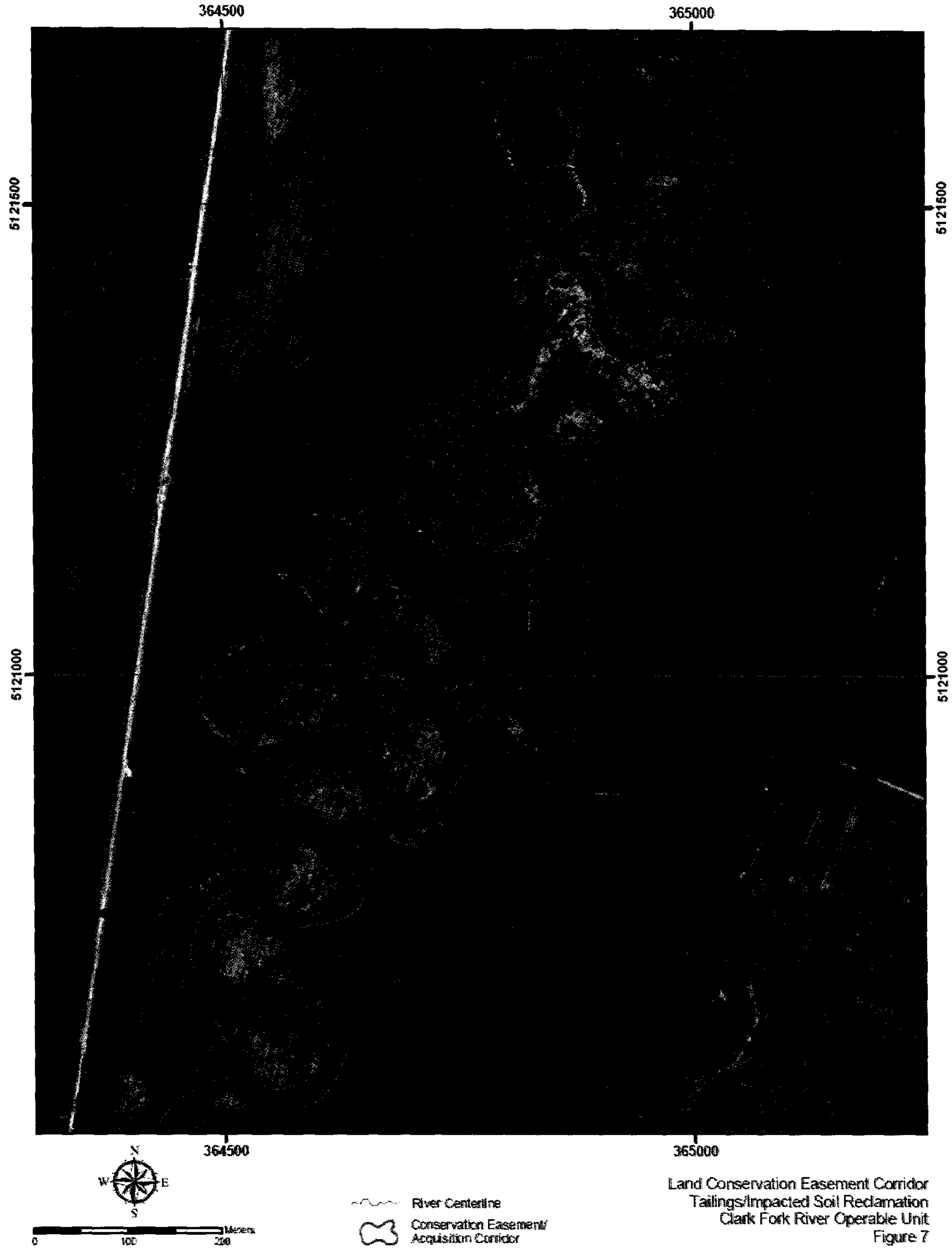
4.7 MONITORING AND MAINTENANCE PROGRAM

The EPA remedial actions include monitoring for groundwater, surface water, and certain biological parameters. Remedial monitoring will appropriately monitor remedial actions to ensure performance standard achievement and relevant site conditions. The Restoration Plan proposes additional monitoring and maintenance to ensure its goals and objectives. For example, one of the restoration goals is to measurably increase vegetation diversity. Monitoring stations may be set up to regularly monitor plant diversity at different locations along the Clark Fork River. Noting the distribution and abundance of plant species over time will allow the improvement of project implementation throughout the construction period. Similarly, another restoration goal is to improve fish habitat and fish recruitment throughout the project area. Fish population and habitat monitoring may focus on the project area and reference streams to track trout population changes.

All aspects of the restoration actions would need to be monitored to evaluate the efficacy of restoration actions and to provide real-time feedback on project successes and failures. This would allow for modifications and improvements to be made to restoration, as well as remedy, designs as the Clark Fork River project progresses. Details of the monitoring program would be established during remediation and restoration design. The monitoring program would be initiated in year zero or year one of construction and continue through the construction period. A 10-year post monitoring program would be established upon completion of the construction. An estimated timeframe for the cleanup and restoration actions is approximately 10 to 15 years.

4.8 COORDINATION OF REMEDIATION AND RESTORATION

All of the tasks discussed above were developed assuming implementation of the ROD as prepared and issued by EPA and concurred on by the State. Coordination of all restoration actions with implementation of EPA's remediation plan is assumed. This coordination will allow for cost savings by combining common tasks conducted by remedy and restoration and through collective purchase of materials and services.



Land Conservation Easement Corridor
Tailings/Impacted Soil Reclamation
Clark Fork River Operable Unit
Figure 7

4.9 RESTORATION ALTERNATIVES

The following sections provide a general description of the potential restoration alternatives that could be implemented. Each alternative was developed using the various potential restoration actions discussed above. All restoration alternatives presented contain certain key restoration activities that the State has determined are necessary regardless of the restoration alternative selected, with the exception of Alternative 2, which does not include removal of streambank contaminated material because of the proposed removal of other contaminated floodplain material. These key actions include removal of streambank contaminated material that is currently or within a short time frame will detrimentally affect the Clark Fork River, flow augmentation to mitigate the effects of residual contamination that will remain in the system for hundreds of years, land acquisition or easement to protect the restoration investment, and monitoring and maintenance of the restoration actions to ensure restoration success. The State has limited the total costs of each alterative to approximately $27.5 million consistent with the settlement amount being earmarked for the Clark Fork site. While terrestrial resources would not be specifically restored, terrestrial resources as described in Section 4.5, will be moved toward a baseline condition with the implementation of these restoration actions.

4.9.1 Alternative 1

This alternative's focus is on Reach A of the Clark Fork River OU. Integration with remedial actions is key to this alternative, which contemplates removal of contaminated floodplain and streambank material and additional actions to restore the riparian resources. The key elements of this alternative include:

1) removal of 90 acres of buried tailings classified as greater than 1 foot in thickness;
2) removal of 67 acres of contaminated soils within 50-feet of outside bends of the river that have been identified as highly erodible;
3) planting of woody vegetation on 201 acres of floodplain tabs;
4) vegetation augmentation on 789 acres;
5) Upper Blackfoot River bull trout restoration;

6) Clark Fork mainstem, Reaches B and C, aquatic improvements – 75%;
7) flow augmentation;
8) land acquisition; and
9) monitoring and maintenance.

4.9.2 Alternative 2

This alternative's focus is on Reach A of the Clark Fork River OU. Integration with remedial actions is key to this alternative that contemplates removal of 700 acres of contaminated floodplain material. Alternative 2 does not include removal of contaminated soils from outside bends of the river, vegetation augmentation and bull trout improvement in the Upper Blackfoot River. The key elements of this alternative include:

1) removal of 700 acres of buried tailings with impacted vegetation;
2) flow augmentation;
3) land acquisition; and
4) monitoring and maintenance.

4.9.3 Alternative 3

This alternative is quite similar to Alternative 1. First, it contemplates removal of contaminated floodplain and streambank materials that are a source to the Clark Fork River. In addition, restoration action on the Upper Blackfoot River is included, and greater restoration on the Clark Fork River mainstem, Reaches B and C, is also included. This alternative, however, includes only 66% of the recommended vegetation augmentation. The key elements of this alternative include:

1) removal of 90 acres of buried tailings classified as greater than 1 foot in thickness;
2) removal of 67 acres of contaminated soils within 50-feet of outside bends of the river that have been identified as highly erodible;
3) planting of woody vegetation on 201 acres of floodplain tabs;
4) Clark Fork River mainstem Reaches B and C, aquatic improvements;
5) Upper Blackfoot River bull trout restoration;

6) Vegetation augmentation 525 acres;
7) flow augmentation;
8) land acquisition; and
9) monitoring and maintenance.

4.9.4 Alternative 4

The only removal contemplated for this alternative is the removal of contaminated streambank materials that continue to be a source of contamination to the Clark Fork River. This streambank removal is different than the other alternatives in that this alternative proposes to remove contaminated material from not only the highly eroding streambanks (67 acres) but an additional 90 acres where contaminated material exists and is eroding into the river. This alternative also considers restoration actions on the Clark Fork mainstem aquatics, Upper Blackfoot River, woody vegetation planting and vegetation augmentation. The key elements of this alternative include:

1) removal of 157 acres of contaminated soils within 50-feet of outside bends of the river that have been identified as highly erodible;
2) Clark Fork River mainstem aquatic improvements 100,000 feet;
3) Upper Blackfoot River bull trout restoration;
4) planting of woody vegetation on 201 acres of floodplain tabs;
5) vegetation augmentation on 789 acres;
6) flow augmentation;
7) land acquisition; and
8) monitoring and maintenance

SECTION 5. COSTS

Costs for the Restoration Plan were developed using the CFROU FS, EPA's cost estimate for the ROD, ARCO's comments to the EPA's Proposed Plan, and NRDP's consultants' estimates. Other sources of information were the Conceptual Restoration Plan for the Clark Fork and Blackfoot Rivers near Milltown Dam, costs associated with Silver Bow Creek restoration, other NRDP restoration projects, and Fish, Wildlife, and Parks projects.

It should be noted that costs for each restoration alternative were developed to cost approximately the $27.5 million which have been earmarked in the settlement for the Clark Fork site. Due to the variations in the alternatives not all the alternatives will cost exactly $27.5 million to implement. Supplemental information for the determination of specific costs of each task is found in Appendix D. Costs for restoration are in addition to remediation costs; however, the costs of these restoration actions assume coordination with remediation, and the State believes that costs savings from this coordination will reduce the costs of restoration actions.

Following is a description of the costs for the restoration actions that are proposed in this restoration plan.

5.1 COSTS OF REMOVAL OF CONTAMINATED TAILINGS AND SOILS FROM FLOODPLAIN

Four tailings removal actions are considered in this plan. The removal of approximately 90 acres of buried tailings greater than one foot thick, the removal of 700 acres of buried tailings proposed to be treated in-situ by remediation, the removal of all contaminated material located adjacent to outside river bends that are highly eroding (approximately 67 acres), and the removal of contaminated material from 157 acres of eroding river bends. These costs were developed using the FS (Pioneer, 2002) and costs from ongoing Silver Bow Creek remediation and restoration activities. The major restoration components of removal include excavation, hauling, and placement of contaminated material, and backfilling with uncontaminated material. Additional assumptions used to develop these costs are discussed in Section 4.1. These costs do not include an estimate of costs for removal actions in Reach B, due to the lack of information in Reach B.

The estimated capital cost of removing the 90 acres of tailings greater than one foot (333,960 cubic yards) is about $4.7 million (Alternatives 1, 2 and 3). The removal cost for the 700 acres to be treated in-place by EPA remedial action (1,550,000 cubic yards) is about $18.5 million (Alternative 2). The two streambank removal alternatives costs are approximately $2.7 million for the 67 acres (Alternatives 1 and 3) and $6.2 million for the 157 acres (Alternative 4).

5.2 COSTS OF AQUATIC RESOURCE IMPROVEMENT

Aquatic resource improvement actions are considered for the Clark Fork River mainstem Reaches B and C, and Upper Blackfoot River restoration. The Clark Fork River mainstem Reaches B and C stream bank and channel stabilization costs are estimated to be about $4.7 million (Alternatives 1, 3, and 4). These restoration activities within Reaches B and C are based on a unit capital cost of $47.42 per foot and the need to work on approximately 100,000 linear feet of the river. The cost per foot is an estimate since a conceptual design has not been developed for the proposed stream bank work. Also, due to budget limitations, only 75 percent of this work would be completed under Alternative One. Restoration costs for the Upper Blackfoot River are estimated based on an estimated amount needed to assist with bull trout and westslope cutthroat trout recovery at approximately $2.5 million (Alternatives 1, 3 and 4).[13] The cost for the aquatic resource

[13] This amount, $2.5 million, would fund about one-third of the amount needed for primary restoration of the five miles of grossly injured streams in the upper Blackfoot River drainage. Another settlement, currently being negotiated, is expected to provide an amount which may also cover these estimated costs for primary restoration. Therefore, it is uncertain whether or not the entire $2.5 million allocated to Blackfoot River bull trout restoration in this plan will be needed. Any unused amount will remain in the Clark Fork River State Restoration Account.

improvements were developed using aquatic resource restoration projects completed in the Upper Clark Fork River Basin.

5.3 COST OF FLOODPLAIN STABILIZATION AND REVEGETATION

Two floodplain stabilization and revegetation options are considered in the alternatives. Floodplain willow enhancement costs are approximately \$209,416 (Alternatives 1, 3, and 4). Reach A willow enhancement costs are associated with the revegetation and establishment of willows on floodplain tabs with less than 40% shrub cover. This estimate assumes that planting devices will be used that are capable of installing willow cuttings three to four feet below ground level. Using a combination of rooted willow stock and willow sprigs, a planting contractor provided an estimated unit cost of \$7.17 per planting (Northwest Revegetation, Personal Communication, February 14, 2003). The floodplain revegetation costs were taken directly from the costs of implementing this activity along Silver Bow Creek (SBC bid tabs). Revegetation augmentation of 789 acres to be treated by remediation is proposed in Alternative 1, 3, and 4. This restoration component cost is approximately \$4.6 million. Due to costs constraints only 525 acres of the revegetation augmentation will be completed in Alternative 3. These costs do not include floodplain willow enhancement and floodplain revegetation in Reach B, due to the lack of information in Reach B.

5.4 FLOW AUGMENTATION COSTS

Under this plan it is assumed that ARCO will convey the water rights to the State to augment flows at Galen to Deer Lodge with a proposed 50 cfs from July 15 to September 15 for 50 years. Therefore, this cost is not included in the costs shown in Table 4. This plan does include costs for a water commissioner at \$16,542 per year for a 50 year period, based on the Montana Department of Fish, Wildlife and Parks annual costs for a water commissioner on the Bitterroot River. This cost is included in all restoration alternatives.

5.5 COSTS OF LAND ACQUISITION / CONSERVATION EASEMENTS

Assuming 2,120 acres in a meander belt width plus 100-foot riparian corridor from Warm Springs Ponds to Garrison, it is estimated that a fee title purchase of this would cost approximately $2.34 million. This cost is considered reasonable in light of the fact that the riparian corridor would not be suitable for residential or commercial use. The cost of purchasing conservation easements should be less. This cost is included in all restoration alternatives.[14]

5.6 Costs of Construction Oversight, Design, Management, and Permitting

Costs for construction oversight (9%), data collection and final project design (8%), and permitting (1%) are a percentage of the total costs for the construction and acquisition portions of this proposal. The percentages used to develop these costs are based on standard industry costs. These costs are shown in Tables 1 through 4.

5.7 Contingency Costs

The contingency for this Restoration Plan is based on 20 percent of the capital costs. This contingency is used to account for the many unknowns associated with the Restoration Plan. For example, the Remedial Investigations assessed only 60 percent of Reach A, leaving 40 percent not investigated. In addition, the Remedial Investigation did not collect data for Reaches B and C, resulting in many unknowns in these reaches and justifying the need for a 20 percent contingency.

5.8 Costs of Monitoring and Maintenance

Monitoring and maintenance costs for each alternative are based on 1 percent of the estimated capital costs per year. This amount is estimated to be needed to monitor restoration actions and complete maintenance at the sites for 10 years.

[14] As part of the pending settlement with ARCO, the State is to receive the 343 acre Beck Ranch, which is not riparian to the Clark Fork River. It is possible that this property, or portions thereof, could be exchanged for fee title or easements to the riparian property sought along the Clark Fork River. The State is also receiving an option from ARCO to take title to a 40 acre parcel on the Clark Fork River upstream of Deer Lodge.

5.9 TOTAL COST OF RESTORATION PLAN

The total costs of each alternative restoration actions are provided in the following tables:

Table 4. Total Cost of Restoration Plan – Alternative 1

Restoration Action	Cost 2006 Dollars	PNV Cost*
Capital Cost:		
Removal of Tailings and Contaminated Soils Buried Tailings >1 foot in Depth (90 acres)	$4,730,094	$4,139,808
Removal of Tailings and Contaminated Soils from Outside Bends of CFR (67 acres)	$2,662,250	$2,330,018
Willow Plantings (201.2 acres)	$209,416	$183,283
Floodplain Revegetation 789 acres	$4,611,679	$4,036,171
Blackfoot River Bull Trout Restoration	$2,500,000	$2,188,016
Clark Fork Mainstem Aquatic Improvements (75%)	$3,556,607	$3,112,766
Flow Augmentation**	$827,118	$469,180
Land Acquisition / Conservation Easements	$2,337,987	$2,046,221
Subtotal Capital Cost:	**$21,435,152**	**$18,505,462**
Miscellaneous Costs:		
Data Collection & Design @ 8%		$1,480,437
Permitting @ 1%		$185,055
Construction Oversight @ 9%		$1,665,492
Contingency @ 20%		$3,701,092
Subtotal w/ Miscellaneous Costs:		**$25,537,538**
Monitoring and Maintenance @ 1%	**2,143,515**	$1,876,538
TOTAL COST REMOVAL ALTERNATIVE		**$27,413,556**

* Costs are assumed to be incurred over a ten-year construction period and are discounted to a present net value using a 2 ½ -percent discount rate.
** Cost of water commissioner only; it is assumed ARCO convey the necessary water rights to the State.

Table 5. Total Cost of Restoration Plan – Alternative 2

Restoration Action	Cost 2006 Dollars	PNV Cost*
Capital Cost:		
Removal of Tailings and Contaminated Soils Buried To be Treated In Place (700 acres)	$18,563,836	$16,247,188
Flow Augmentation**	$827,118	$469,180
Land Acquisition / Conservation Easements	$2,337,987	$2,046,221
Subtotal Capital Cost:	**$21,728,941**	**$18,762,589**
Miscellaneous Costs:		
Data Collection & Design @ 8%		$1,501,007

Permitting @ 1%		$187,626
Construction Oversight @ 9%		$1,688,633
Contingency @ 20%		$3,752,518
Subtotal w/ Miscellaneous Costs:		**$25,892,373**
Monitoring and Maintenance @ 1%	**$2,172,894**	**$1,901,731**
TOTAL COST REMOVAL ALTERNATIVE		**$27,794,104**

* Costs are assumed to be incurred over a ten-year construction period and are discounted to a present net value using a 2 ½ -percent discount rate.
** Cost of water commissioner only; it is assumed ARCO convey the necessary water rights to the State.

Table 6. Total Cost of Restoration Plan – Alternative 3

Restoration Action	Cost 2006 Dollars	PNV Cost*
Capital Cost:		
Removal of Tailings and Contaminated Soils from Outside Bends of CFR (67 acres)	$2,662,250	$2,330,018
Removal of Tailings and Contaminated Soils Buried Tailings >1 foot in Depth (90 acres)	$4,730,094	$4,139,808
Willow Plantings (201.2 acres)	$209,416	$183,283
Blackfoot River Bull Trout Restoration	$2,500,000	$2,188,016
Clark Fork Mainstem Aquatic Improvements	$4,742,143	$4,150,354
Floodplain Revegetation 525 acres	$3,068,608	$2,685,665
Flow Augmentation**	$827,118	$469,180
Land Acquisition / Conservation Easements	$2,337,987	$2,046,221
Subtotal Capital Cost:	**$21,077,616**	**$18,601,621**
Miscellaneous Costs:		
Data Collection & Design @ 8%		$1,488,130
Permitting @ 1%		$186,016
Construction Oversight @ 9%		$1,674,146
Contingency @ 20%		$3,720,324
Subtotal w/ Miscellaneous Costs:		**$25,670,238**
Monitoring and Maintenance @ 1%	**$2,107,762**	**$1,844,726**
TOTAL COST REMOVAL ALTERNATIVE		**$27,514,964**

* Costs are assumed to be incurred over a ten-year construction period and are discounted to a present net value using a 2 ½ -percent discount rate.
** Cost of water commissioner only; it is assumed ARCO convey the necessary water rights to the State.

Table 7. Total Cost of Restoration Plan – Alternative 4

Restoration Action	Cost 2006 Dollars	PNV Cost*
Capital Cost:		
Removal of Tailings and Contaminated Soils from Outside Bends of CFR (157 acres)	$6,238,402	$5,459,889
Floodplain Revegetation 789 acres	$4,611,679	$4,036,171

Restoration Action	Cost 2006 Dollars	PNV Cost*
Willow Plantings (201.2 acres)	$209,416	$186,283
Clark Fork Mainstem Aquatic Improvements	$4,742,143	$4,150,354
Blackfoot River Bull Trout Restoration	$2,500,000	$2,188,016
Flow Augmentation**	$827,118	$469,180
Land Acquisition / Conservation Easements	$2,337,987	$2,046,221
Subtotal Capital Cost:	**$21,466,745**	**$18,533,113**
Miscellaneous Costs:		
Data Collection & Design @ 8%		$1,482,649
Permitting @ 1%		$185,331
Construction Oversight @ 9%		$1,667,980
Contingency @ 20%		$3,704,623
Subtotal w/ Miscellaneous Costs:		**$25,575,697**
Monitoring and Maintenance @ 1%	**$2,146,675**	**$1,878,783**
TOTAL COST REMOVAL ALTERNATIVE		**$27,454,480**

* Costs are assumed to be incurred over a ten-year construction period and are discounted to a present net value using a 2 ½ -percent discount rate.
** Cost of water commissioner only; it is assumed ARCO convey the necessary water rights to the State.

Most of the above costs are assumed to be incurred over a ten-year construction period and are discounted to a present net value using a 2 ½ -percent discount rate. Certain costs are discounted for other periods as noted in the detailed spreadsheet found in Appendix D.

SECTION 6. CONCLUSIONS AND PREFERRED ALTERNATIVE

The overall goal of this Restoration Plan is to restore the condition of the Upper Clark Fork River and the riparian area of the floodplain to a condition more closely resembling baseline conditions. Baseline conditions represent the estimated condition of the river corridor in the absence of natural resource injuries caused by the hazardous substances released by ARCO and its predecessor's mining related operations. Specific Restoration Plan goals are:

- Restoration of aquatic life in the Upper Clark Fork River to baseline conditions.
- Restoration of native trout (bull trout and westslope cutthroat trout) to the Clark Fork River drainage.
- Restoration of wildlife habitat to baseline conditions along the riparian zones and floodplains of the Upper Clark Fork River and its tributaries.

- Offsetting the residual effects to flora and fauna from hazardous substances that are not eliminated from the aquatic system.
- Maximizing the long-term beneficial effects and cost-effectiveness of restoration activities.
- Improvement of natural aesthetic values and increasing recreational use of the Upper Clark Fork River and its tributaries.

The State selects Alternative 1 as the alternative that will best accomplish the Restoration Plan goals in the most effective manner. Implementation of this preferred alternative will result in noticeable recovery of natural resources toward baseline in a relatively short-period of time compared to no action. However, even with the removal of tailings, extensive revegetation, and other restoration actions associated with this Restoration Plan, the Upper Clark Fork River and the surrounding area will not return completely to a baseline condition for a long period of time due to large amounts of mining waste that will remain in the channel and floodplain.

Integration with remedial actions is key to this alternative, which contemplates removal of contaminated floodplain and streambank material and additional actions to restore the riparian resources. The key elements of this alternative include:

- Removal of 90 acres of buried tailings classified as greater than 1 foot in thickness;
- Removal of 67 acres of contaminated soils within 50-feet of outside bends of the river that have been identified as highly erodible;
- Planting of woody vegetation on 201 acres of floodplain tabs;
- Floodplain Vegetation augmentation on 789 acres;
- Restoration of bull trout and westslope cutthroat trout in the Clark Fork River drainage at the Upper Blackfoot River;
- Aquatic habitat improvements along the Clark Fork mainstem, Reaches B and C;
- Flow augmentation;
- Land acquisition; and
- Monitoring and maintenance.

The State believes that the majority of these restoration elements augment the remedial actions outlined in the ROD; however, two of the proposed actions, if finally approved, would replace the remedy selected in the ROD. First, the 90 acres of buried tailings that are greater than 1 foot in thickness would be removed, rather than treated in place as contemplated by remedial action. Second, although the remedial action would remove contaminated soils within 50-feet of outside bends of the river, restoration would remove another 67 acres, resulting in further removal within the 50-feet of outside bends of the river. Subject to the provisions of the Clark Fork River Consent Decree (assuming that it is subsequently approved by the Federal District Court), components of the State's restoration plan which propose restoration actions in lieu of remedy would be subject to review and approval by EPA, and would be performed with EPA oversight.

This plan does have significant short-term impacts associated with the areas proposed for removal. During implementation, and until vegetation establishes deep-binding roots, the floodplain of the river will remain at risk of increased erosion during over-bank flow flood events. It is estimated that 10 to 15 years will be required to complete the removal and revegetation activities associated with the Plan. A dense, stabilizing vegetative cover may be established quickly (5 to 10 years) under ideal conditions; however, hydrologic fluctuations could result in a longer period of time for the vegetation to establish and may require periodic enhancements in strategic areas for several decades (L. Kapustka, Personal Communication, December 23, 2003).

Aquatic resources could substantially recover in 10 to 20 years (NRDP, 1995b). By removing the most contaminated areas within the meander belt of the Clark Fork River and reconstructing and stabilizing stream banks between Warm Springs Ponds and Milltown, inputs of hazardous substances to the river would be measurably reduced. The removal of contaminant sources and flow augmentation would ameliorate, but not eliminate, the toxicity of residual surface water and bed sediment contamination. The reduction of contaminant levels and completion of fishery habitat projects within the river would clearly benefit trout populations by reducing exposure of aquatic life to hazardous substances. It is estimated that trout populations will significantly increase because of the reduction in hazardous substances loadings to the Clark Fork River (NRDP, 1995b). Increasing the amount and quality of fish habitat in the river and the Blackfoot River will also benefit native trout and other trout populations in the Clark Fork River.[15] The improvements to fish habitat and water quality within the Clark Fork River and Blackfoot River would significantly decrease the time needed for trout populations to reach this level of recovery.

[15] Restoring the Upper Blackfoot River to accommodate bull trout and other native trout is, in one sense, natural resource "replacement" of such trout which once existed in the Upper Clark Fork River. As mentioned above, direct restoration of bull trout in the upper most part of the Clark Fork Basin is not feasible due to residual contamination and other habitat limitations.

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